

REMARKS

Claims 1-15 are pending for the Examiner's review and consideration.

Rejection 1

Claims 1-4, 6, 8 and 10-14 were rejected under 35 U.S.C. § 103(a) over commonly owned WO 00/41212 to Ni et al. ("Ni") in view of U.S. Patent No. 4,980,204 to Fujii et al. ("Fujii"). The reasons for the rejection are stated at pages 2-4 of the Official Action. The Official Action alleges that it would have been obvious to combine Fujii's apparatus having a plurality of gas outlets with the gas injector of Ni. The rejection is respectfully traversed.

Independent Claims 1 and 10 recite a plasma processing system, which comprises, *inter alia*, the features of a gas injector having a distal end exposed in a processing chamber, "*the gas injector including a plurality of gas outlets supplying process gas at flow rates that are independently varied between at least some of the outlets into the processing chamber.*" (emphasis added). Ni and Fujii fail to suggest the combinations of features recited in Claims 1 and 10.

The Official Action asserts that Ni shows the invention substantially as claimed, including a gas injector 22. However, the Official Action acknowledges that Ni "fails to expressly disclose a gas injector including a plurality of gas outlets supplying gas at flow rates that are independently varied and wherein the gas outlets are supplied process gas by a single gas supply" (Official Action at page 3). The gas injector 22 shown in Fig. 3A of Ni referred to in the Official Action includes central bore 44 and gas outlets 46, all of which are in fluid communication with the central bore.

The Official Action asserts that Fujii discloses a gas injector having a plurality of outlets 111-114 connected to a single gas supply line and that independent flow rate control is provided by gas flow control valves 13-16. With respect to Claim 4, the Official Action asserts that Fujii discloses on-axis and off-axis outlets. It is further asserted in the Official Action that it would have been obvious to one having ordinary skill in the art to have modified the apparatus of Ni to include the gas injector structure of Fujii. Applicants respectfully disagree with these assertions for the following reasons.

Claims 1 and 10 are directed to a gas injector having a distal end, *i.e.*, a single gas injector that includes a plurality of gas outlets in a single distal end. Fujii does not disclose or suggest a single gas injector having a plurality of gas outlets in a distal end, but rather Fujii discloses a plurality of separate vent pipes 111, 112, 113 and 114 having distal ends. The separate vent pipes 111, 112, 113 and 114 of Fuji are not provided in a distal end of a gas injector (See Fujii at column 4, lines 30-31 and Figure 3).

It is well established that during patent examination, the claims undergoing examination must be given their "broadest reasonable interpretation consistent with the specification." MPEP §2111. However, the broadest reasonable interpretation must be consistent with the interpretation that those skilled in the art would reach. *In re Cortright*, 165 F.3d 1353, 1359, 49 USPQ2d 1464, 1468 (Fed. Cir. 1999). In the present case, the claim language "a distal end" has been misinterpreted.

The claim term "a distal end" has been given an unreasonable meaning in the final Official Action by construing the claimed "a distal end" to read on a plurality of ends 108 of individual pipes 111, 112, 113 and 114 shown in Figure 3 of Fujii. The final Official

Action takes the untenable position that the individual ends in Fujii's Figure 3 arrangement collectively form "a distal end." As explained below, the interpretation of the claimed "a distal end" in the final Official Action is in error because it is not consistent with the interpretation that those skilled in the art would reach. See, *Cortright, supra*.

Claims 1 and 10 recite a plasma processing system comprising a gas injector having a distal end exposed within the processing chamber, the gas injector including a plurality of gas outlets supplying process gas at flow rates that are independently varied between at least some of the outlets into the processing chamber. Fujii, in contrast, discloses a plurality of vent pipes (See abstract). Each vent pipe of Fujii has its own distal end. It is respectfully submitted that a proper interpretation of the claimed "a distal end" excludes the multiple distal ends of the separate vent pipes in Figure 3 of Fujii.

Regarding Claim 4, Applicants respectfully submit that Fujii fails to disclose on-axis and off-axis outlets as asserted at page 4 of the Official Action. Rather, Fujii discloses that the "vent pipes are aligned in a line vertical to the substrate" (See Fujii at column 8, lines 13-18). Furthermore, while Fujii discloses that the "spouting ends of vent pipes may be arranged...unsymmetrically with regard to the center of the substrate surface" (See Fujii at column 8, lines 19-27), Fujii does not disclose or suggest a plurality of off-axis outlets in a side surface of a gas injector, as recited in Claim 4. Accordingly, the rejection is improper and should be withdrawn.

Rejection 2

Claim 5, 7 and 9 were rejected under 35 U.S.C. § 103(a) over Ni and Fujii in further view of U.S. Patent No. 5,160,543 to Ishihara et al. ("Ishihara"). The reasons for

the rejection are stated at pages 4-5 of the Official Action. Specifically, the Official Action alleges that it would have been obvious to combine the gas injector configuration of Ishihara with the apparatus of Ni as modified by Fujii. The rejection is respectfully traversed.

Claim 5, which depends from Claim 1, recites, *inter alia*, a gas injector including a plurality of gas outlets supplying process gas at *flow rates that are independently varied between at least some of the outlets* into the processing chamber, the gas outlets being supplied process gas by a *single gas supply*, wherein the gas outlets include a center gas outlet extending in an axial direction perpendicular to the exposed surface of the substrate and *a plurality of angled gas outlets extending at an acute angle to the axial direction*, the center gas outlet receiving process gas supplied by a first gas line and the angled gas outlets receiving process gas from a second gas line, the first and second gas lines receiving process gas from the single gas supply.

As acknowledged in the Official Action, Ni fails to disclose or suggest a gas injector "including a plurality of gas outlets supplying gas at flow rates that are independently varied and wherein the gas outlets are supplied process gas by a single gas supply." As discussed above, both Ni and Fujii fail to disclose *a gas injector* including a plurality of gas outlets supplying gas at flow rates that are *independently varied* from a single gas supply.

Ishihara fails to remedy the deficiencies of Ni and Fujii. Ishihara discloses an apparatus that includes gas introducing pipes 209, 210 and a gas introducing port 211 (See column 5, lines 55-68). However, Ishihara does not disclose "a plurality of angled gas outlets 210" as asserted in the Official Action at page 4. Rather, Ishihara discloses a

"double concentric arrangement structure" (See Ishihara at column 5, lines 55-56). The structure comprises a first gas introducing pipe 209 surrounded coaxially by a second gas introducing pipe 210 (Ishihara at column 5, lines 57-59). Referring to Figure 2 of Ishihara, "211 is the gas introducing port constituting the tip portions of the gas introducing pipes 209 and 210" (See Ishihara at column 5, lines 60-63). Thus, Ishihara fails to disclose a plurality of "angled" outlets in an injector.

Ishihara fails to disclose or suggest a gas injector including a plurality of gas outlets supplying gas at flow rates that are *independently varied* from a single gas supply. Ishihara discloses gas bombs 201-205 and mass flow controllers 201b-205b for controlling the flow rates of gases from the *respective bombs* (See Ishihara at column 5, lines 38-46). Accordingly, the combination of Ishihara with Ni and Fujii does not produce the combination of features recited in Claim 5. For at least the foregoing reasons, Claim 5 is deemed to be patentable over the combination of Ni, Fujii and Ishihara.

Claim 7 recites a plasma processing system, which comprises, *inter alia*, a gas injector including a planar axial end face having an on-axis outlet therein and a *conical side surface having off-axis outlets therein*, the on-axis outlet receiving process gas from a central passage in the injector and the off-axis outlets receiving process gas from an annular passage surrounding the central passage; *the gas injector supplying process gas at flow rates that are independently varied between at least some of the outlets* including the on-axis outlet into the processing chamber (emphasis added). Ni, Fujii and Ishihara fail to suggest the plasma processing system recited in Claim 7 for the following reasons.

As acknowledged in the Official Action, Ni fails to disclose or suggest a gas injector "including a plurality of gas outlets supplying gas at flow rates that are independently varied and wherein the gas outlets are supplied process gas by a single gas supply."

Furthermore, Ni does not disclose a conical surface having off-axis outlets therein, as recited in Claim 7. Ni also does not disclose "off-axis outlets receiving process gas from an annular passage surrounding the central passage," as recited in Claim 7.

Fujii fails to cure the deficiencies of Ni with respect to the plasma processing system recited in Claim 7. As discussed above, Fujii does not suggest a single injector that includes a plurality of gas outlets much less a gas injector including an on-axis outlet *and* off-axis outlets, as recited in Claim 7. Furthermore, Fujii does not suggest the feature of "the gas injector supplying process gas at flow rates that are independently varied between at least some of the outlets including the on-axis outlet into the processing chamber." As such, the combination of Fujii with Ni does not suggest the combination of features recited in Claim 7.

Ishihara fails to cure the deficiencies of Ni and Fujii with respect to the plasma processing system recited in Claim 7. As discussed above with respect to Claim 5, Ishihara fails to disclose a gas injector having a conical side surface having off-axis outlets therein. Ishihara discloses a concentric arrangement structure for introducing gases from separate gas bombs (See column 5, lines 54-63; column 6 lines 55-61 and Figures 2-3). The gas introducing port of Ishihara "constitutes the tip portions of the gas introducing pipes" and not a conical side surface having off-axis outlets therein (See column 5, lines 54-63). The gas introducing port of Ishihara is located in an axial end surface, not in a conical side

surface, as recited in Claim 7. Furthermore, Ishihara does not suggest the feature of "the gas injector supplying process gas at flow rates that are independently varied between at least some of the outlets including the on-axis outlet into the processing chamber."

Accordingly, the combination of Ni, Fujii and Ishihara does not suggest the combination of features recited in Claim 7. Applicants respectfully submit that the combination of features recited in Claim 7 is patentable over Ni, Fujii Ishihara.

Claim 9 recites a plasma processing system, which comprises, *inter alia*, a gas injector including at least one *on-axis outlet which injects process gas in an axial direction perpendicular to a plane parallel to an exposed surface of the substrate* and *off-axis gas outlets which inject process gas at an acute angle relative to the plane parallel to the exposed surface of the substrate*, the gas injector supplying process gas at *flow rates that are independently varied* between at least some of the outlets into the processing chamber (emphasis added). Ni, Fujii and Ishihara fail to suggest the plasma processing system recited in Claim 9 for the following reasons.

Ni fails to suggest a gas injector including at least one on-axis outlet and off-axis outlets that supply process gas at flow rates that are independently controlled.

Fujii and Ishihara fail to cure the deficiencies of Ni with respect to the plasma processing system recited in Claim 9. As discussed above, neither Ni, Fujii nor Ishihara suggest the combination of features recited in Claim 9 which includes a "gas injector supplying process gas at *flow rates that are independently varied* between at least some of the outlets." As such, the combination of Ni, Fujii and Ishihara cannot possibly suggest the combination of features recited in Claim 9 which includes "at least one on-axis outlet...and

off-axis outlets...the gas injector supplying process gas at *flow rates that are independently varied between at least some of the outlets* into the processing chamber."

Rejection 3

Claim 15 was rejected under 35 U.S.C. § 103(a) over Ni in view of Fujii and further in view of U.S. Patent No. 6,287,643 to Powell et al. ("Powell"). The reasons for the rejection are stated at page 5 of the Official Action. Specifically, the Official Action alleges that it would have been obvious to combine the conducting shield of Powell with the injector apparatus of Ni and Fujii. The rejection is respectfully traversed.

Powell was cited in the Official Action for the disclosure of a gas injection tube 84 provided with an electrically conductive shield. It is not seen, however, how Powell can be combined with Ni absent impermissible hindsight. Powell discloses a remote plasma source 70 comprising an outer tube 72 used for plasma confinement and excitation, and an inner coaxial tube 84 used for importing gas to the chamber (See column 8, lines 13-18). An external RF coil 78 is wound about the plasma confinement tube 72 (See column 8, lines 37-38). Ni discloses a gas injector centrally mounted in a plasma etch reactor wherein a plasma is confined in an area above the substrate (See Ni at page 9, lines 8-22). Ni does not, however, provide the motivation to avoid plasma generation within the injector. The Official Action has not set forth a tenable basis establishing the requisite motivation to combine Powell with Ni and Fujii in a manner that would produce the claimed system. However, even if Powell is combined with the injector of Ni, the resulting combination fails to produce the plasma processing system recited in Claim 1, from which Claim 15

depends. Accordingly, the combination of features recited in Claim 15 is patentable over Ni, Fujii and Powell. Therefore, withdrawal of the rejection is respectfully requested.

Rejection 4

Claims 1-4, 6, 8 and 10-14 were rejected under 35 U.S.C. § 103(a) over Ni in view of Fujii in further view of U.S. Patent No. 4,105,810 to Yamazaki et al. ("Yamazaki"). The reasons for the rejection are stated at pages 5-7 of the Official Action. The Official Action alleges that it would have been obvious to combine Yamazaki's apparatus having a plurality of gas outlets with the gas injector of Ni. Also, the Official Action alleges that it would have been obvious to have a single gas supply line connected to independent gas outlets. The Official Action further alleges that it would have been obvious to add the gas flow controllers of Fujii to the apparatus of Ni modified by Yamazaki. The rejection is respectfully traversed.

The deficiencies of Ni and Fujii with respect to the combination of features recited in Claims 1 and 10 are discussed above. Yamazaki fails to cure the deficiencies of Ni and Fujii, as explained below.

The Official Action asserts that Yamazaki discloses an apparatus comprising a gas injector having a plurality of gas outlets that are independently connected to a single gas supply line (See Official Action at page 7). Applicants respectfully disagree. Yamazaki discloses an apparatus having an oxygen source 1 and a carrier gas source 2 (See column 6, lines 47-57 and Figure 1). The carrier gas is used to transport raw materials to a reactor (See column 6, lines 47-57 and Figure 1). While Yamazaki discloses a carrier source 2 connected to bubblers 5, 6 and 7 via flow meters 3 and valves 4 (See column 6, lines 53-57

and Figure 1), Yamazaki fails to disclose a gas injector comprising a plurality of gas outlets wherein the flow of process gas is *independently varied between at least some of the outlets*, as recited in independent Claims 1 and 10. Accordingly, Ni, Fujii and Yamazaki fail to suggest the combinations of features recited in Claims 1 and 10, as well as in the claims dependent therefrom. Withdrawal of the rejection is respectfully requested.

Rejection 5

Claim 15 was rejected under 35 U.S.C. § 103(a) over Ni in view of Yamazaki and Fujii and further in view of Powell. The reasons for the rejection are stated at page 8 of the Official Action. Specifically, the Official Action alleges that it would have been obvious to combine the conducting shield of Powell with the injector apparatus of Ni, Yamazaki and Fujii. The rejection is respectfully traversed.

As explained above, Powell fails to cure the deficiencies of Ni and Fujii with respect to the plasma processing system recited in Claim 1, from which Claim 15 depends. As discussed above in Rejection 3, the Official Action fails to establish the requisite motivation for selecting an isolated teaching in Powell and adding it to Ni. Accordingly, the combination of features recited in Claim 15 is patentable over Ni, Yamazaki, Fujii and Powell. Therefore, withdrawal of the rejection is respectfully requested.

Rejection 6

Claims 1-14 were rejected under 35 U.S.C. § 103(a) over Ni in view of Ishihara and Fujii. The reasons for the rejection are stated at pages 8-10 of the Official Action. The Official Action alleges that it would have been obvious to modify the apparatus of Ni with the gas injector structure of Ishihara. The Official Action also alleges that it would have

been obvious to modify the apparatus of Ni as modified by Ishihara to further comprise the gas flow controller of Fujii, and alleges that it would have been obvious to have made a single gas supply line connected to independent gas outlets. The rejection is respectfully traversed.

The combination of Ni, Ishihara and Fujii was also applied against Claims 5, 7 and 9 (see above discussion under "Rejection 2"). As explained therein, Ishihara fails to cure the deficiencies of Ni and Fujii as applied to Claims 5, 7 and 9.

Claim 1 recites a plasma processing system comprising a plasma processing chamber; a vacuum pump connected to the processing chamber; a substrate support on which a substrate is processed within the processing chamber; a dielectric member having an interior surface facing the substrate support, wherein the dielectric member forms a wall of the processing chamber; a gas injector extending through the dielectric member such that a distal end of the gas injector is exposed within the processing chamber, *the gas injector including a plurality of gas outlets supplying process gas at flow rates that are independently varied between at least some of the outlets* into the processing chamber, the gas outlets being supplied process gas by a single gas supply; and an RF energy source which inductively couples RF energy through the dielectric member and into the chamber to energize the process gas into a plasma state to process the substrate.

Claim 10 recites a plasma processing system comprising a plasma processing chamber; a vacuum pump connected to the processing chamber; a substrate support on which a substrate is processed within the processing chamber; a dielectric member having an interior surface facing the substrate support, wherein the dielectric member forms a wall

of the processing chamber; a gas injector removably mounted in an opening in the dielectric member and extending through the dielectric member such that a distal end of the gas injector is exposed within the processing chamber, a vacuum seal being provided between the gas injector and the dielectric window, *the gas injector including a plurality of gas outlets supplying process gas at flow rates that are independently varied between at least some of the outlets* into the processing chamber; and an RF energy source which inductively couples RF energy through the dielectric member and into the chamber to energize the process gas into a plasma state to process the substrate.

Ishihara does not suggest the feature of a gas injector including a plurality of gas outlets supplying process gas at flow rates that are *independently varied* between at least some of the outlets gas. Instead, Ishihara discloses a concentric tube arrangement wherein the distal ends of the inner and outer tubes form a central outlet and a surrounding annular outlet, both in the distal end of the coaxial tube arrangement. The inner and outer tubes of Ishihara are connected to different gas supplies. Accordingly, the combination of Ni, Ishihara and Fujii cannot possibly produce the various combinations of features recited in Claims 1-14. Withdrawal of the rejection is respectfully requested.

Rejection 7

Claim 15 was rejected under 35 U.S.C. § 103(a) over Ni in view of Ishihara and Fujii and further in view of Powell. The reasons for the rejection are stated at page 11 of the Official Action. Specifically, the Official Action alleges that it would have been obvious to combine the conducting shield of Powell with the injector apparatus of Ni, Ishihara and Fujii. The rejection is respectfully traversed.

As explained above in Rejection 3, impermissible hindsight is needed to provide the necessary incentive to selectively add the conductive shield of Powell to the injector of Ni. The combination of features recited in Claim 15 is thus patentable over Ni, Ishihara, Fujii and Powell. Therefore, withdrawal of the rejection is respectfully requested.

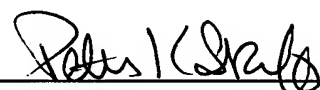
Conclusion

It is submitted that the differences between the claimed subject matter and the prior art are such that the claimed subject matter, as a whole, would not have been obvious at the time the invention was made to a person having ordinary skill in the art.

In view of the foregoing, it is submitted that the present application is in condition for allowance and such action is earnestly solicited.

Respectfully submitted,

BURNS, DOANE, SWECKER & MATHIS, L.L.P.

By: 
Peter K. Skiff
Registration No. 31,917

P.O. Box 1404
Alexandria, Virginia 22313-1404
(703) 836-6620
Date: September 16, 2003